



# national accelerator laboratory

Radiation Physics Note #5  
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To: Radiation Physics Staff, RSO's  
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Subject: Film Badge and Dosimeter Tests

A series of test film badge and dosimeter irradiations has been conducted under realistic beam-off field conditions in the accelerator transfer hall and Enclosure H. The tests were conducted in fields that were surveyed using a recently calibrated Cutie Pie and care was used to pick uniform ( $\pm 5\%$ ) fields.

First a comparison was made between the exposure values reported by Landauer and the expected exposures based on integrated Cutie Pie readings. These results are summarized in Table I and show that reported film badge exposures are reasonably accurate above 100 mR.

Table I

<u>Dose in mR</u>	<u>Number of badges</u>	<u>Average % error</u>	<u>Standard Deviation of % error</u>
10-40	27	- 47%	50%
40-100	7	- 10%	14%
100-600	69	- 1.5%	7.4%

Exposures below 20 mR are not reliably reported by Landauer. A total of 16 badges were given exposures between 10 mR and 20 mR of which 9 were reported as "minimal". No badges receiving more than 20 mR were reported as "minimal".

Four of the badges were originally reported by Landauer to have received exposures considerably greater than that administered. (Table II)

Table II

<u>Film Badge Number</u>	<u>Given Dose</u>	<u>Initial Reported Dose</u>	<u>Dose upon rereading</u>
2580	m	90 mR	m
0014	100 mR	200 mR	120 mR
9549	150 mR	290 mR	320 mR
9395	150 mR	220 mR	220 mR

Film badges 2580 and 0014 were ascribed to human error in the initial reading. One was caused by using the wrong calibration correction factor for that film and the second by misreading the densitometer. No explanation was found for the anomalous readings of 9395 and 9549. If this sample of 113 badges is representative, this would indicate an apparent misreading rate of several per cent.

A second comparison was made between dosimeter readings and film badge exposures in an attempt to duplicate the reported discrepancies of up to 50% under field use conditions. Test badges and dosimeters were irradiated simultaneously as described above. Table III presents a data summary from these tests.

Table III

<u>Dosimeter Type</u>	<u>Number of Dosimeters Used</u>	<u>Average Dosimeter Reading</u>	<u>Number of film badges used</u>	<u>Average film badge reading</u>	<u>% difference</u>
200 mR	6	114 mR	9	119 mR	- 4%
200 mR	11	162 mR	10	187 mR	-13%
200 mR	11	125 mR	8	137 mR	- 9%
1 R	5	380 mR	8	400 mR	- 6%
1 R	11	439 mR	10	532 mR	-17%

New dosimeters were used for these tests and were recalibrated at the end of the irradiation (10 months later). No significant deterioration in dosimeter sensitivity was observed over this time span. The results in Table II indicate that our dosimeters do consistently read low relative to film badges when exposed in the same radiation fields. Under these controlled exposures, however, the magnitude of the discrepancies is much less than that reported during actual field use.

A third study was conducted of the gamma ray dose fading of our film badges. A set of 25 badges was exposed to a nominal dose of 500 mR in the transfer hall. The badges were then divided into five groups of five badges each. The first group was sent into Landauer and read immediately and the remaining groups sent in at

one month intervals with our regular shipments. The badges were stored in a desk drawer in the Central Laboratory while awaiting shipment. Table IV lists the results of this study and shows a definite  $\gamma$  dose fading with time that totals 13% over a four month period.

Table IV

<u>Film Badge Group</u>	<u>Reading Delay</u>	<u>Average Landauer Reading</u>	<u>% Difference from given dose</u>
1	2 days	534 mR	+6.8%
2	1 month	530 mR	+6.0%
3	2 months	480 mR	-4.0%
4	3 months	478 mR	-4.4%
5	4 months	468 mR	-6.4%

Conclusions

- (1) Landauer does not reliably report exposures under 20 mR.
- (2) Exposures over 100 mR are reported with reasonable ( $\pm 10\%$ ) accuracy.
- (3) Significant misreading errors occur at a rate of several per cent of the badges read.
- (4) Under test conditions our dosimeters read consistently low by anywhere from 5% to 20%, and averaged about 10% low.
- (5) A 13% fading of gamma ray exposures was observed over a period of four months. This effect should be small or negligible for normal film badge wear periods.